

C L A I M S

We Claim:

1. A medical laser delivery apparatus for delivering one or more pulses to an area
2. of tissue to be treated and generating a region of coagulation to a controllable coagulation
3. depth under a surface of the area of tissue comprising a laser source for generating a series of
4. one or more non-ablative pulses to be delivered to the area of tissue to be treated in order to
5. raise a temperature at the surface of the area of tissue to be treated to a temperature sufficient
6. to generate coagulation at the coagulation depth when the laser source is in a coagulation
7. mode.

1. The medical laser delivery apparatus as claimed in claim 1 further comprising a
2. laser delivery system coupled to the laser source for delivering the one or more pulses from
3. the laser source to the area of tissue to be treated.

1. 3. The medical laser delivery apparatus as claimed in claim 2 wherein the laser
2. delivery system comprises an articulated arm and one or more refocussing optics for
3. refocussing the laser pulses as they travel through the arm.

1. 4. The medical laser delivery apparatus as claimed in claim 3 wherein the laser
2. delivery system further comprises a scanning handpiece at an end of the arm for providing the
3. laser pulses to the area of tissue being treated.

1. 5. The medical laser delivery apparatus as claimed in claim 4 wherein the
2. refocussing optics are simple convex lenses.

1 6. The medical laser delivery apparatus as claimed in claim 1 further comprising a
2 graphical user interface through which a user selects the coagulation depth and/or fluence.

1 7. The medical laser delivery apparatus as claimed in claim 6 wherein the laser
2 source also has an ablation mode wherein it generates laser pulses of a strength and duration
3 to ablate tissue at the area of tissue being treated to an ablation depth and the user selects the
4 ablation depth through the graphical user interface.

1 8. The medical laser delivery apparatus as claimed in claim 1 wherein the laser
2 source includes a laser having a short penetration depth.

1 9. The medical laser delivery apparatus as claimed in claim 8 wherein the laser is
2 an erbium laser.

1 10. The medical laser delivery apparatus as claimed in claim 8 wherein the laser is
2 an Er:YAG laser.

1 11. A medical laser comprising:
2 a. a laser source for generating a laser beam having a predetermined absorption
3 length, wherein the absorption length forms a predetermined coagulation depth
4 in response to an ablative laser pulse; and
5 b. a laser control system, coupled for controlling the laser source for generating a
6 plurality of coagulative laser pulses, such that each such coagulative laser pulse
7 is delivered in sequence to a target area to form a coagulation region deeper
8 than the predetermined coagulation depth.

12. The medical laser as claimed in claim 11 further comprising a graphical user
1 interface through which a user selects a depth of the coagulation region formed by the
2 coagulative laser pulses.

13. The medical laser as claimed in claim 12 further comprising a laser delivery
2 system coupled to the laser source for delivering the laser beam from the laser source to an
3 area of tissue to be treated.

14. The medical laser as claimed in claim 13 wherein the laser delivery system
2 comprises an articulated arm and one or more refocussing optics for refocussing the laser
3 beam as it travels through the arm.

15. A method of delivering laser pulses to an area of tissue to be treated and
2 generating coagulation to a controllable coagulation depth under a surface of the tissue
3 comprising the steps of:

- 4 a. generating a series of one or more non-ablative pulses from a laser source;
- 5 b. delivering the series of one or more non-ablative pulses to the area of tissue to
6 be treated in order to raise the tissue to be treated to a temperature sufficient to
7 generate coagulation at the coagulation depth.

16. The method of delivering laser pulses as claimed in claim 15 further
2 comprising the step of displaying a graphical user interface through which a user selects the
3 coagulation depth.

17. A medical laser delivery apparatus for treating an area of tissue comprising:
2 a. a laser source for generating a series of one or more laser pulses each having a
3 strength and a duration;

4 b. a laser delivery system coupled to the laser source for delivering the laser
5 pulses from the laser source to the area of tissue being treated;
6 c. a control system coupled to the laser source for controlling generation of the
7 laser pulses from the laser source, wherein the laser source operates in both an
8 ablation mode and a coagulation mode such that when in the ablation mode, the
9 strength and duration of the laser pulses are sufficient to ablate tissue at the
10 area of tissue being treated to a controllable ablation depth and when in the
11 coagulation mode, the strength and duration of the laser pulses are sufficient to
12 generate a coagulation region having a controllable coagulation depth within the
13 tissue remaining at the area of tissue being treated without ablating any tissue.

18. The medical laser delivery apparatus as claimed in claim 17 further comprising
1 a graphical user interface through which a user selects the controllable ablation depth and the
2 controllable coagulation depth.

19. The medical laser delivery apparatus as claimed in claim 18 wherein the laser
1 delivery system comprises an articulated arm and one or more refocussing optics for
2 refocussing the laser beam as its travels through the articulated arm.

20. The medical laser delivery apparatus as claimed in claim 19 wherein the laser
1 delivery system further comprises a scanning handpiece at an end of the arm for providing the
2 laser pulses to the area of tissue being treated.

21. The medical laser delivery apparatus as claimed in claim 20 wherein the
1 refocussing optics are simple convex lenses.

22. The medical laser delivery apparatus as claimed in claim 21 wherein the laser
1 source includes a laser having a short penetration depth.

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1 The medical laser delivery apparatus as claimed in claim 22 wherein the laser
2 is an erbium laser.

1 24. The medical laser delivery apparatus as claimed in claim 22 wherein the laser
2 is an Er:YAG laser.

1 25. A graphical user interface for monitoring and controlling operation of a medical
2 laser system in the treatment of an area of tissue comprising:

- 3 a. an ablation control section through which a user selects a desired ablation depth
4 specifying how much tissue is to be ablated at the area of tissue being treated;
- 5 b. a coagulation control section through which a user selects a desired coagulation
6 depth specifying how thick a coagulation region is to be generated at the area
7 of tissue being treated; and
- 8 c. a representation of the area of tissue being treated illustrating the selected
9 ablation depth and the selected coagulation depth.

1 26. The graphical user interface as claimed in claim 25 wherein the representation
2 of the area of tissue being treated displays the selected ablation depth and the selected
3 coagulation depth in numeric form and represents the selected ablation depth and the selected
4 coagulation depth in a graphical form.

1 27. The graphical user interface as claimed in claim 26 wherein the graphical user
2 interface operates in a scanning mode and a non-scanning mode.

1 28. The graphical user interface as claimed in claim 27 further comprising a scan
2 pattern control section which is displayed when the graphical user interface is in the scanning
3 mode and through which the user selects a desired scan pattern and scan size.

1 29. The graphical user interface as claimed in claim 28 further comprising a rate
2 selection control section which is displayed when the graphical user interface is in the non-
3 scanning mode and through which the user selects the rate at which laser pulses are to be
4 delivered to the area of tissue being treated.

1 30. A method of monitoring and controlling a medical laser system in the treatment
2 of an area of tissue comprising the steps of:

- 3 a. displaying a plurality of ablation depths from which a desired ablation depth is
4 selected, wherein the ablation depth specifies how much tissue is to be ablated
5 at the area of tissue being treated;
- 6 b. displaying a plurality of coagulation depths from which a desired coagulation
7 depth is selected, wherein the coagulation depth specifies how thick of a
8 coagulation region is to be generated at the area of tissue being treated; and
9 c. displaying a representation of the area of tissue being treated illustrating the
10 selected ablation depth and the selected coagulation depth.

1 31. The method as claimed in claim 30 wherein the representation of the area of
2 tissue being treated displays the selected ablation depth and the selected coagulation depth in
3 numeric form and represents the selected ablation depth and the selected coagulation depth in
4 a relative graphical form.

1 32. The method as claimed in claim 31 further comprising the step of displaying a
2 plurality of scan patterns and scan sizes from which a desired scan pattern and a desired scan
3 size are selected.

1 33. The method as claimed in claim 32 further comprising the step of displaying a
2 plurality of rates of delivery of laser pulses from which a desired rate of delivery is selected.

1 34. A medical laser delivery system for delivering a laser beam from a laser source
2 to an area of tissue to be treated by the laser beam comprising one or more focussing optics
3 for refocusing the laser beam as it travels through the delivery system.

1 35. The medical laser delivery system as claimed in claim 34 further comprising an
2 articulated arm in which the focussing optics are mounted and through which the laser beam
3 travels.

1 36. The medical laser delivery system as claimed in claim 35 wherein the
2 articulated arm includes one or more directing optics for directing the laser beam from the
3 laser source through the articulated arm to the area of tissue to be treated.

1 37. The medical laser delivery system as claimed in claim 36 wherein the focussing
2 optics are simple convex lenses.

1 38. An articulated arm laser delivery system for delivering a laser beam from a
2 laser source to an area of tissue to be treated by the laser beam comprising:
3 a. a first arm component;
4 b. a second arm component;
5 c. a joint coupling the first arm component and the second arm component;
6 d. a plurality of directing optics for directing the laser beam from the laser source
7 through the first arm, the joint and the second arm to the area of tissue to be
8 treated; and
9 e. one or more focussing optics for refocusing the laser as it travels through the
10 first and second arms.

1 39. The articulated arm laser delivery system as claimed in claim 38 further
2 comprising a scanning handpiece mounted on an end of the second arm component and
3 through which the laser beam is delivered to the area of tissue to be treated.

1 40. The articulated arm laser delivery system as claimed in claim 39 wherein the
2 focussing optics are simple convex optics.

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